

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
6 November 2003 (06.11.2003)

PCT

(10) International Publication Number  
**WO 2003/091355 A3**

(51) International Patent Classification<sup>7</sup>: **C09K 11/06**,  
H05B 33/14

(21) International Application Number:  
PCT/GB2003/001765

(22) International Filing Date: 24 April 2003 (24.04.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
0209652.7 26 April 2002 (26.04.2002) GB

(71) Applicant (for all designated States except US): **CAMBRIDGE UNIVERSITY TECHNICAL SERVICES LIMITED** [GB/GB]; The Old Schools, Trinity Lane, Cambridge CB2 1TS (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HOLMES, Andrew** [AU/GB]; 19 Newton Road, Cambridge, CB2 2AL (GB).

**SANDEE, Albertus** [NL/NL]; Faustdreef 141, NL-3561 LD Utrecht (NL). **WILLIAMS, Charlotte** [GB/GB]; c/o Cambridge University Technical Services Limite, d, The Old Schools, Trinity Lane, Cambridge CB2 1TS (GB). **KOEHLER, Anna** [DE/GB]; Peterhouse, Trumpington Street, Cambridge CB2 1RD (GB). **EVANS, Nick** [NZ/GB]; 190 Chesterton Road, Cambridge CB4 1NE (GB).

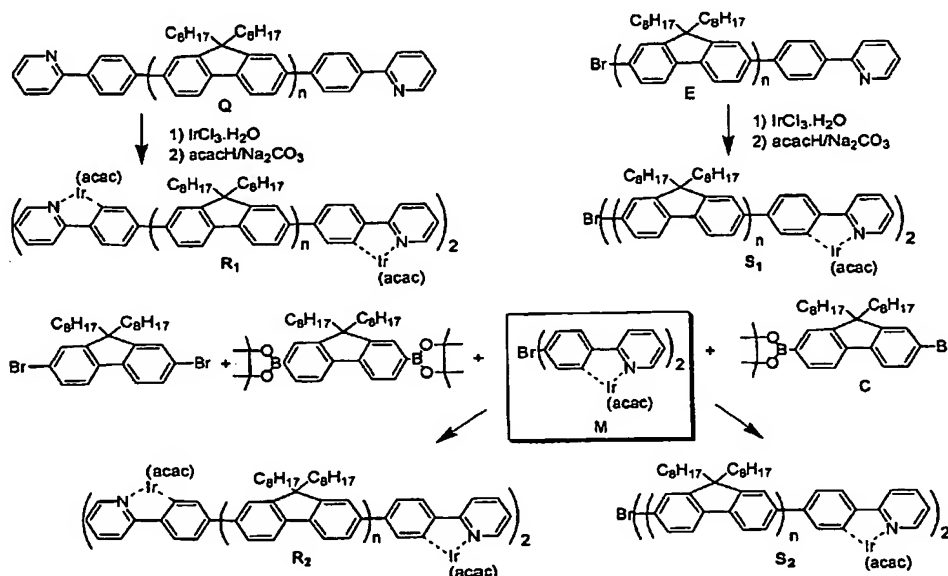
(74) Agents: **DANIELS, Jeffrey, Nicholas et al.**; Page White & Farrer, 54 Doughty Street, London WC1N 2LS (GB).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: SOLUTION-PROCESSABLE PHOSPHORESCENT MATERIALS



(57) Abstract: A material capable of luminescence comprising: a polymer or oligomer; and an organometallic group characterised in that the polymer or oligomer is at least partially conjugated and the organometallic group is covalently bound to the polymer or oligomer and the nature, location and/or proportion of the polymer or oligomer and of the organometallic group in the material are selected so that the luminescence predominantly is phosphorescence.



European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(88) Date of publication of the international search report:  
4 March 2004

**Published:**

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# INTERNATIONAL SEARCH REPORT

Internal application No  
PCT/GB 03/01765

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 C09K11/06 H05B33/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C09K H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, CHEM ABS Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 138 746 A (SUMITOMO CHEMICAL CO) 4 October 2001 (2001-10-04) claims 1-17; examples 5-7	1-26, 30
X	WO 02 31896 A (DU PONT) 18 April 2002 (2002-04-18) cited in the application page 5, line 22 - line 27; claims 1, 18, 20, 23; example 23	1-26
X	US 2001/019782 A1 (KIMURA KEIZO ET AL) 6 September 2001 (2001-09-06) paragraph '0105! - paragraph '0106! paragraph '0124!	1-26
	-/--	

☒ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

### \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

21 July 2003

Date of mailing of the international search report

05. 12. 2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Lehnert, A.

## INTERNATIONAL SEARCH REPORT

 Interna .pplication No  
 PCT/GB 03/01765

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	NG P K ET AL: "QUINOXALINE-BASED CONJUGATED POLYMERS CONTAINING RUTHENIUM(II) BIPYRIDINE METAL COMPLEX" MACROMOLECULAR: RAPID COMMUNICATIONS, WILEY VCH, WEINHEIM, DE, vol. 18, no. 12, 1 December 1997 (1997-12-01), pages 1009-1016, XP000738968 ISSN: 1022-1336 cited in the application the whole document	1-26,30
X	WONG W-Y; LU G-L; CHOI K-H; SHI J-X: "Synthesis and Electronic Properties of New Photoluminescent Platinum-Containing Polyynes with 9,9-Dihexylfluorene and 9-Butylcarbazole Units" MACROMOLECULES, vol. 35, 2002, - 19 March 2002 (2002-03-19) pages 3506-3513, XP002248213 cited in the application the whole document	1-26,30
X	WONG C T ET AL: "YELLOW LIGHT-EMITTING POLY(PHENYLENEVINYLENE) INCORPORATED WITH PENDANT RUTHENIUM BIPYRIDINE AND TERPYRIDINE COMPLEXES" ADVANCED MATERIALS, VCH VERLAGSGESELLSCHAFT, WEINHEIM, DE, vol. 11, no. 6, 16 April 1999 (1999-04-16), pages 455-459, XP000829960 ISSN: 0935-9648 cited in the application the whole document	1-26,30
X	US 5 442 021 A (HEILIGER LUDGER) 15 August 1995 (1995-08-15)  column 4, line 55 - column 5, line 25; claims 1-4	1-3,6-9, 11, 13-16, 19,20
P,X	WO 03 001616 A (TAKEUCHI MASATAKA ;ITO NAKO (JP); NAIJO SHUICHI (JP); KAMACHI MOT) 3 January 2003 (2003-01-03) the whole document	1-26,30
P,X	WO 03 018653 A (JAPAN BROADCASTING CORP ;SHOWA DENKO KK (JP)) 6 March 2003 (2003-03-06)  -/--	1-26,30

# INTERNATIONAL SEARCH REPORT

Intern Application No

PCT/GB 03/01765

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	<p>-&amp; DATABASE WPI  Section Ch,  Derwent Publications Ltd., London, GB;  Class A85, AN 2003-332823  XP002248214  abstract</p> <p>-----</p> <p>EP 1 245 659 A (SUMITOMO CHEMICAL CO)  2 October 2002 (2002-10-02)  the whole document</p> <p>-----</p>	1-26,30

# INTERNATIONAL SEARCH REPORT

In **national application No.**  
PCT/GB 03/01765

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☒ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-26, 30

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

-----  
Continuation of Box I.2

Claims Nos.: -

Present claims 1-26 relate to an extremely large number of possible luminescent materials, use of these luminescent materials in optical devices and optical devices comprising this material as well as processes for preparing these materials. In fact, the claims contain so many options, variables, possible permutations and provisos that a lack of clarity (and conciseness) within the meaning of Article 6 PCT arises to such an extent as to render a meaningful search of the claims impossible.

Support within the meaning of Article 6 PCT and disclosure within the meaning of Article 5 PCT is to be found, however, for only a very small proportion of the luminescent materials, their use in optical devices and the processes for preparing these materials.

Consequently, the search has been carried out for those parts of the application which do appear to be clear (and concise), namely iridium-containing fluorenyl polymers or oligomers, a method for their production and their use in electroluminescent devices as disclosed on page 56 of the application and a reasonable generalisation thereof.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

# INTERNATIONAL SEARCH REPORT

## Patent Family Annex

Information on patent family members

International Application No

F IB 03/01765

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1138746	A	04-10-2001	EP 1138746 A1	04-10-2001
			JP 2001342459 A	14-12-2001
			US 2002027623 A1	07-03-2002
WO 0231896	A	18-04-2002	AU 1532202 A	22-04-2002
			CA 2423886 A1	18-04-2002
			WO 0231896 A2	18-04-2002
US 2001019782	A1	06-09-2001	JP 2001345183 A	14-12-2001
			JP 2001247859 A	14-09-2001
US 5442021	A	15-08-1995	DE 4305959 A1	01-09-1994
			DE 59402958 D1	10-07-1997
			EP 0612772 A1	31-08-1994
			JP 6256429 A	13-09-1994
WO 03001616	A	03-01-2003	JP 2003119179 A	23-04-2003
			JP 2003113246 A	18-04-2003
			JP 2003147021 A	21-05-2003
			JP 2003077675 A	14-03-2003
			JP 2003073666 A	12-03-2003
			WO 03001616 A2	03-01-2003
WO 03018653	A	06-03-2003	WO 03018653 A1	06-03-2003
			US 2003091862 A1	15-05-2003
EP 1245659	A	02-10-2002	EP 1245659 A1	02-10-2002
			US 2002193532 A1	19-12-2002